THE INFORMATION CONTENT OF MULTIBASELINE POLARIMETRIC RADAR INTERFEROMETRY

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Remote sensing of vegetated land surfaces is the estimation of vegetation and surface parameters from some combination of remote sensing observations. This paper presents candidate simple models **M** which express multibaseline polarimetric radar interferometric observations in terms of vegetation and surface parameters to be estimated. The estimation of a vector of vegetation and surface parameters, $\vec{V}$ from remote sensing observations $\vec{O}$ can be schematically represented as

$$\vec{V} = \mathbf{M}^{-1}\vec{O} \tag{1}$$

For fixed-baseline (as opposed to repeat-pass) fully polarimetric interferometry, which will soon be available on the JPL TOPSAR system (H. A. Zebker et al., *IEEE Transactions on Geoscience and Remote Sensing*, **30**, 933-940, 1992), $\vec{O}$ will consist of the interferometric phases and amplitudes, for all polarization combinations at each end of each baseline, and the usual, zero-baseline radar polarimetry (e.g. W. M. Boerner et al., *IEEE Trans. Ant. and Prop.*, **AP-29**, 262-271, 1981). The quantities estimated in the parameter vector $\vec{V}$ will depend on the model being used to construct **M**. For example, for scalar (nonpolarimetric) interferometry, for a homogeneous, single-layer, horizontal, randomly oriented volume model (R. N. Treuhaft et al., *Radio Science*, **31**, 1449-1485, 1996), the elements of $\vec{V}$ are vegetation height, extinction coefficient, and underlying topography; the elements of $\vec{O}$ are the amplitude and phase of one or more baselines at a single polarization. The more extensive $\vec{O}$ of multibaseline polarimetric interferometry allows the possibility of extracting much more information, by estimating a more accurate, complete, and realistic $\vec{V}$.

This paper explores the information content of multibaseline polarimetric interferometry by augmenting the randomly-oriented volume model with models treating surface reflections and oriented volumes. For example, the introduction of surface scattering introduces parameters having to do with the ground reflection coefficients and the specular scattering amplitude of the volume (for surface-volume returns). Considering an oriented volume introduces parameters having to do with the index of refraction and extinction coefficient of each eigenpolarization in the oriented volume.

The program of the paper will be 1) show the parameter sets necessary to describe the above model scenarios, 2) show that adding zero-baseline polarimetry to single-polarization multibaseline interferometry does not improve parameter estimation performance, 3) show that multibaseline polarimetric interferometry does improve parameter estimation, and 4) show results of first-generation multibaseline interferometry taken over central Oregon.

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